

## **Data Science Module on Bias and Multivariable Thinking**

**Prerequisites/Assumptions.**

**Duration.**

**Tips for teaching.**

### **Additional Reading**

1. ???
2. ???

Lecture – See Bias and Multivariate Thinking.pptx

Assessment – Homework 3

### **Learning Outcome – Bias and Multivariate Thinking (Confounding)**

#### **Goal #1: Bias**

##### Key Ideas

The goal of any study is to use accurate and reliable data.

Bias is any systematic differences between the sample and the population (or the estimate and the true value).

This can be due to:

- Types of units that are excluded from the sample
- Process of collecting or manipulating data

Ideally, we want to eliminate bias from our studies. However, it is often not possible to fully eliminate bias, especially when we did not collect the data ourselves. In this case, you should identify the bias and the direction of bias (did you overestimate or underestimate?).

##### Video Resource

- [Types of Bias](#) – FilaMentors (AP Stat teacher)

## Goal #2: Multivariate Thinking

### Key Ideas

Often, we think about comparing variables, not realizing the impact of other unobserved variables (or those excluded from our analysis). Multivariate thinking includes these other potential confounders.

A **confounding variable** is a variable that is related to the explanatory variable and the response variable and changes the observed relationship between the two. A potential confounder is any variable related to the explanatory and response variables. Non-experiments are very susceptible to confounders.

Recall that...”Correlation does not necessarily imply causation”

### Video Resource

- [Correlation vs. Causation Overview](#) – StatisticsLectures.Com
- [How Ice Cream Kills: Correlation vs. Causation](#) – DecisionSkills
- Article: [How Anecdotal Evidence Can Undermine Scientific Results](#)

Additional Video Resources:

**Data Gathering:**

<u>Medium</u>	<u>Statistical Topic</u>	<u>Application Area</u>	<u>Source</u>	<u>Title</u>	<u>PCI</u>	<u>Rating (S/P/E)</u>
<a href="#">Video</a>	Experimental Designs		jedwadchapman	Describes the process of designing an experiment	C	4/4/2
<a href="#">Video</a>	Experimental Designs		BackmanAcademy	Explains Experimental Design	C	5/2/2
<a href="#">Video</a>	Experimental Designs	Placebo Effect	TED	Eric Mead (magician) proves that, even when you know something's not real, you can still react as powerfully as if it is	C	/5/5
<a href="#">Video</a>	Experimental Designs, Sampling	Pizza	Against All Odds	See Videos #14, 15, and 16 - Using historical anecdotes and contemporary applications, this introduction to the series explores the vital links between statistics and our everyday world. The program also covers the evolution of the discipline.	C/P	//
<a href="#">Video</a>	Experimental Designs	Business, Social Justice	TED	Michael Norton talks about how money does buy happiness when you give money to others	I	/5/4
<a href="#">Video</a>	Experimental Designs	Food Science	TED	Malcolm Gladwell on Spaghetti Sauce	I	/5/5
<a href="#">Video</a>	Experimental Designs		TED	Esther Duflo present social experiments to fight poverty	I	
<a href="#">Video</a>	Observational Studies, Experimental Designs		MrsBrownHC			5/3/1
<a href="#">Video</a>	Observational Studies	Public Health	Gapminder	Hans Rosling compares two nordic countries, Denmark and Norway that, at different times, introduced the Pap smear screening and the effect it has had on the number of women who got cancer.	I	/5/5

<a href="#">Video</a>	Observational Studies	Public Health	Gapminder	Hans Rosling shows that colon cancer gets more common when countries get richer	I	/5/5
<a href="#">Video</a>	Observational Studies	Global Development	Gapminder	Hans Rosling details UK's 200-year journey, to present time, and also shows that China, in the coming five years, will narrow the gap to UK faster than ever.	I	/5/5
<a href="#">Video</a>	Observational Studies	Politics, Technology	BackmanAcademy	Explains Observational Studies	P	
<a href="#">Video</a>	Confounders	Health	Mary DiGiorgi	Examples Controlling for Confounding	C	5/3/1
<a href="#">Video</a>	Confounders	Dog Ownership	BackmanAcademy	Explains Confounding Variables	C	5/3/2
<a href="#">Video</a>	Confounders	Health	Khan Academy	Correlation and Causality, Based on Article Khan discusses whether eating breakfast makes you healthier	C	5/5/3
<a href="#">Video</a>	Confounders	Health	Paris L'Ecole	Humorous correlation does not imply causation	I	5/4/5